Status of the upgrade of RFX-mod2

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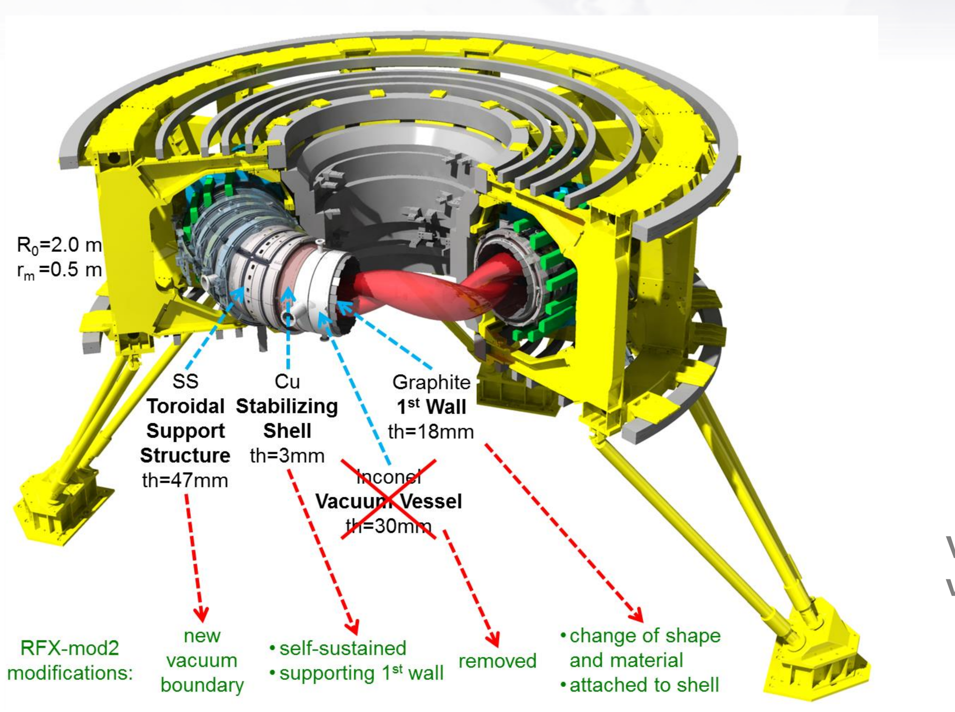
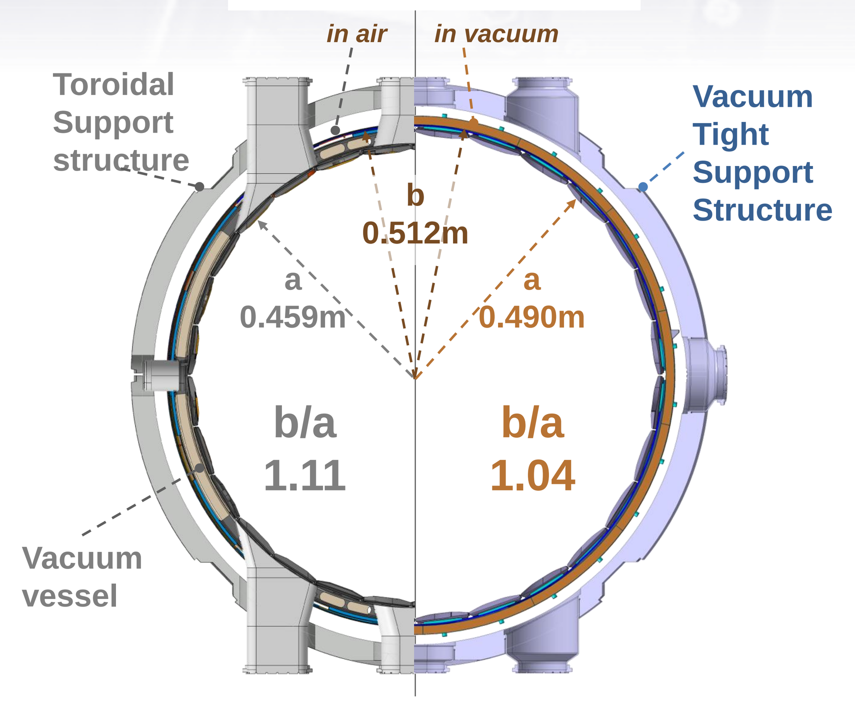
Abstract

- *The RFX-mod Reversed Field Pinch device passive boundary is being improved*
  - *Drastic reduction of resistivity of first shell surrounding the plasma*
  - *Reduction of plasma-stabilizing conductor distance from b/a=1.11 to b/a=1.04*
- *The RFX-mod core upgrades consist of*
  - *Removal of Inconel vacuum vessel*
  - *Modification of the stainless steel Support Structure to ensure Vacuum Tightness (VTSS)*
  - *Modification of the copper Passive Stabilizing Shell (PSS)*
  - *Installation of upgraded sensors inside the vacuum vessel*
- *Initial main points of investigation in the new device are discussed*

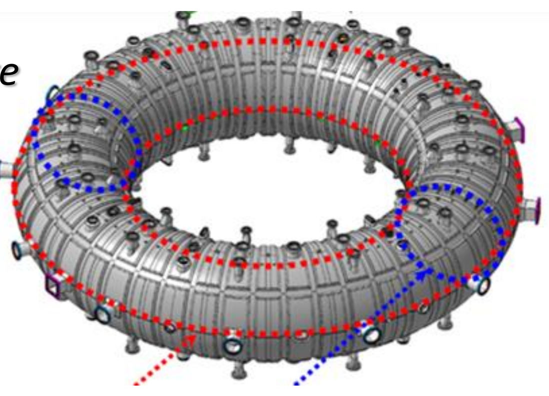
From RFX-mod to RFX-mod2

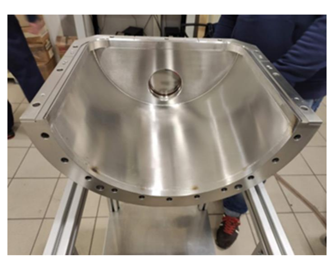




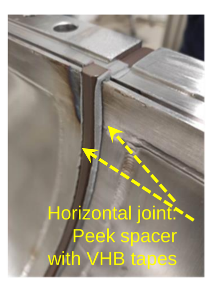
1 Vacuum Tight Support Structure (VTSS)

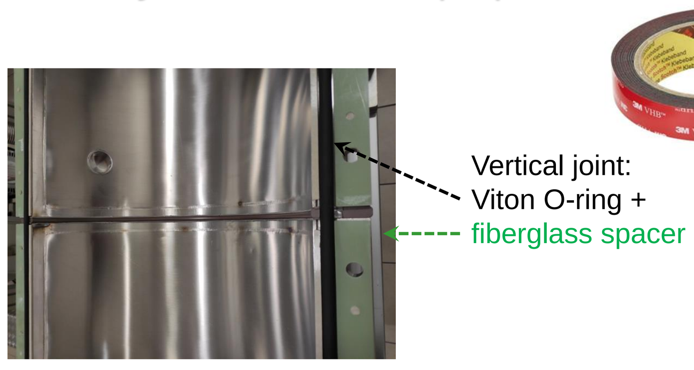
- *In RFX-mod2 vacuum is provided by the modified Toroidal Structure*
- *The VTSS has two poloidal and two toroidal gaps: crossed vacuum tight and electrically insulated joints need to be implemented*
  - *The toroidal joints adopt a Viton® O-ring*
  - *The poloidal joints adopt a 3M™ VHB™ (Very High Bond) visco-elastic acrylic-based syntactic foam tape on a PEEK spacer, qualified for vacuum.* (new)
- *Vacuum tightness and compatibility has been verified on a mock-up up to 90°C*





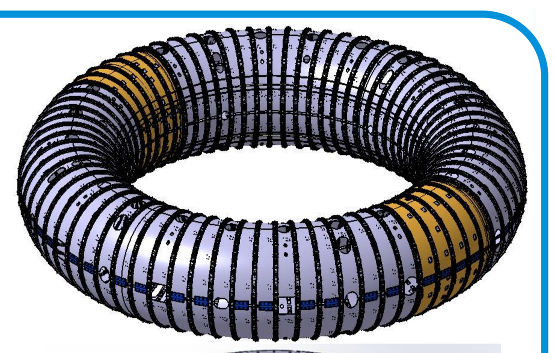
VTSS crossed joint mockup

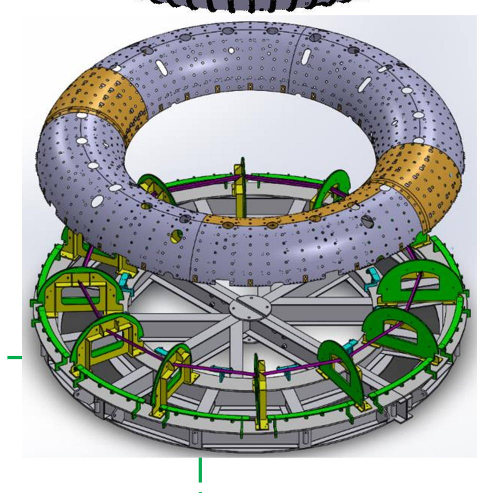


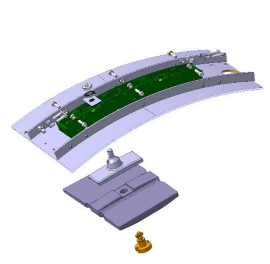


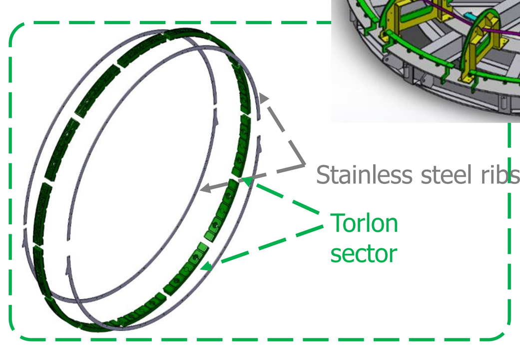
2 Passive Stabilizing Shell (PSS)

- *RFP ideal modes are stabilized by the former RFX-mod copper shell*
- *Differently from RFX-mod*
  - *The shell is self sustained and also supports first wall by means of 72 Torlon rings*
  - *The shell is in vacuum, protected by and insulated from graphite tiles*
- *Two overlapped poloidal gaps reduce the probability of arcing in anomalous conditions* (new)
- *The shell will be entirely insulated by plasma sprayed alumina*
- *Assembly procedures are being tested on a dedicated mock-up*



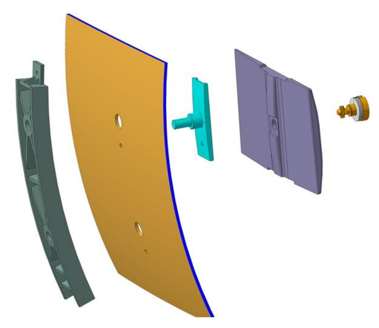


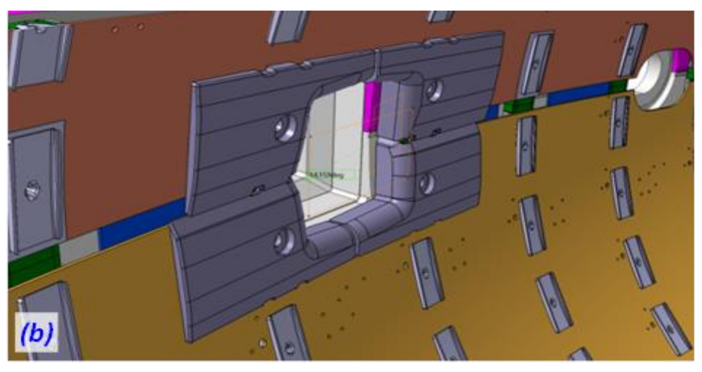




3 Plasma Facing Components

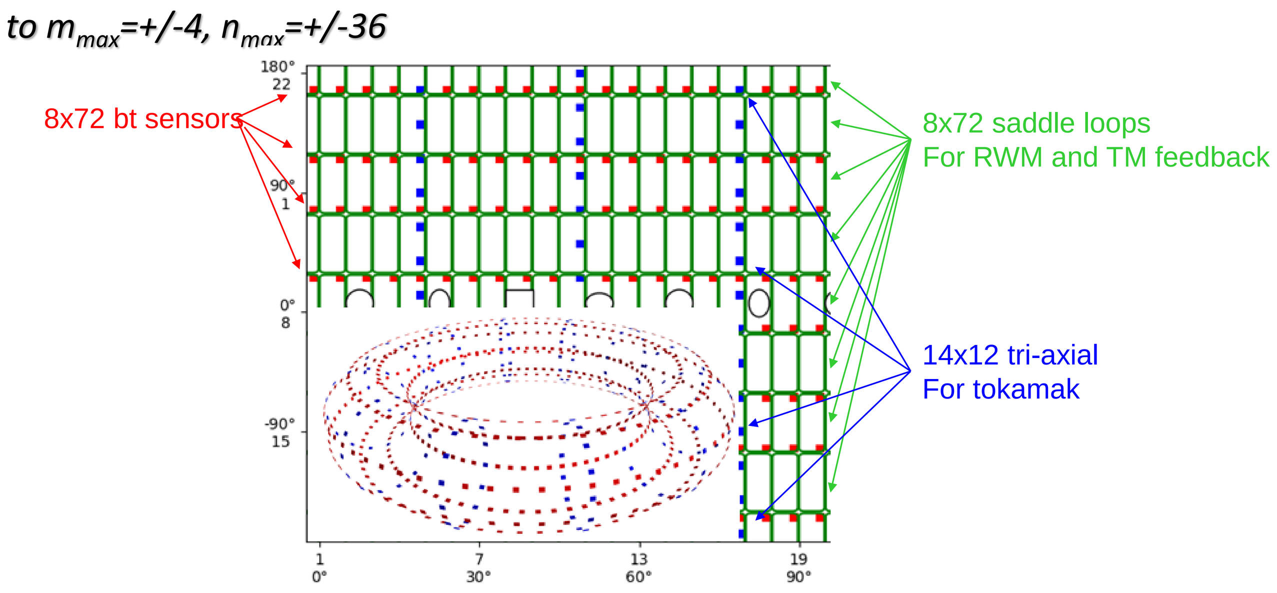
- *Graphite tiles will be attached directly to the Passive Stabilizing Shell*
  - *New design: rounded leading edges to protect shell*
    - *Reduce localized power deposition*
  - *New material: high thermal conductivity graphite (165 W·m^{-1}K^{-1})*
    - *Reduce temperature during discharge*

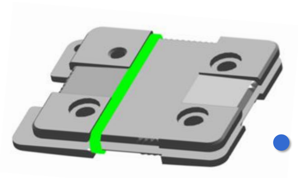




4 New and Upgraded Diagnostics: magnetic sensors

- *Significant increase of magnetic measurements resolution (up to 200kHz)*
  - *Spatial resolution up to m_{max}=+/-4, n_{max}=+/-36*

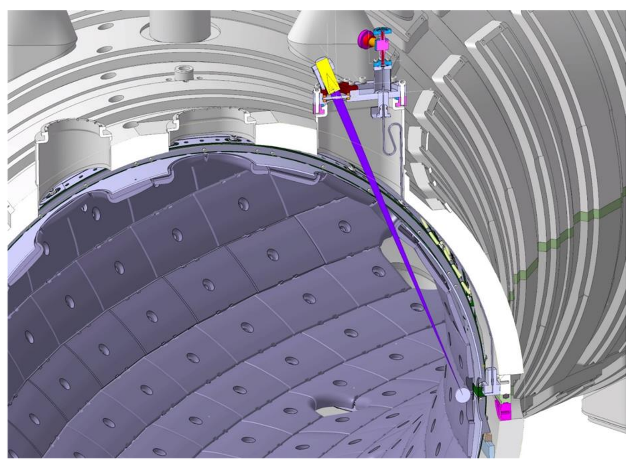




- *1 poloidal and partial toroidal array of High Frequency (5MHz) magnetic field*

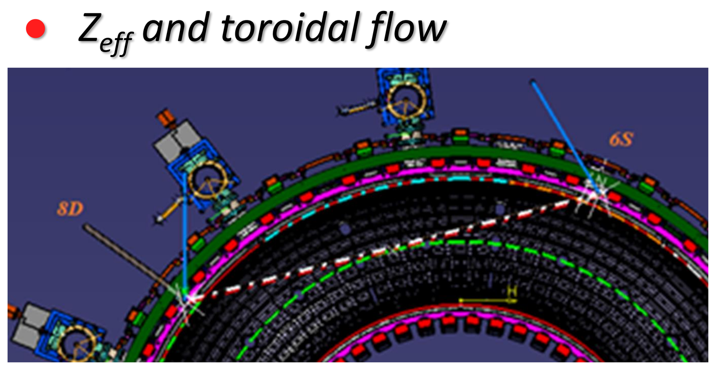
5 New and Upgraded Diagnostics: 2

- *Thermal Helium Beam*
  - *4 poloidal positions*

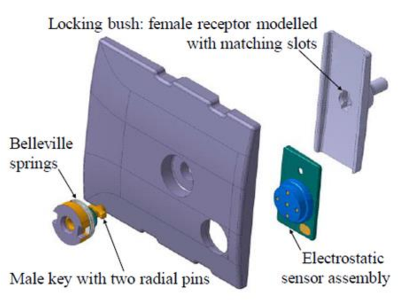


- *Solid pellet injector for encapsulated Ni-tracer pellets*

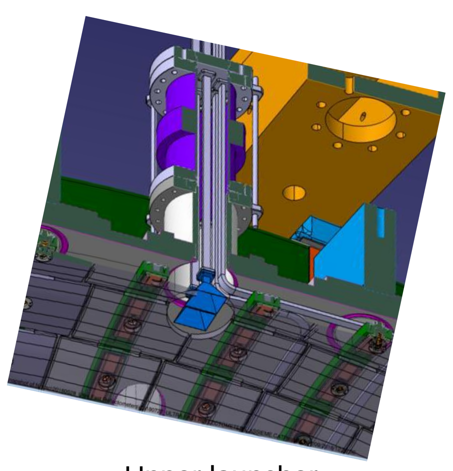
- *Z_{eff} and toroidal flow*



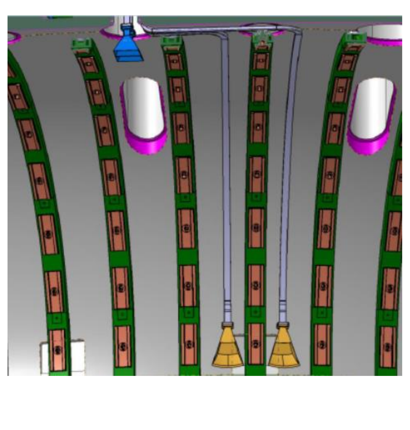
- *Electrostatic probes hosted in modified graphite tiles*
  - *2 toroidal arrays of 71 probes*
  - *1 poloidal arrays of 18 single probes*
  - *2 arrays of 5-pin balanced probes*
  - *1 array of 18 ball-pen probes (measuring T_e without biasing)*



- *Plasma position reflectometer for tokamak configuration*
  - *Gaps measured in 4 poloidal positions*



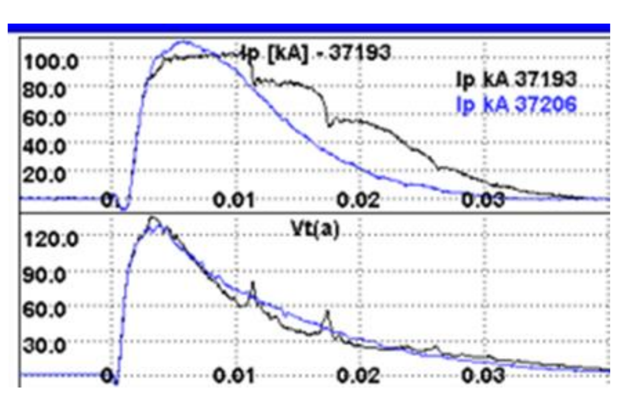
Upper launcher



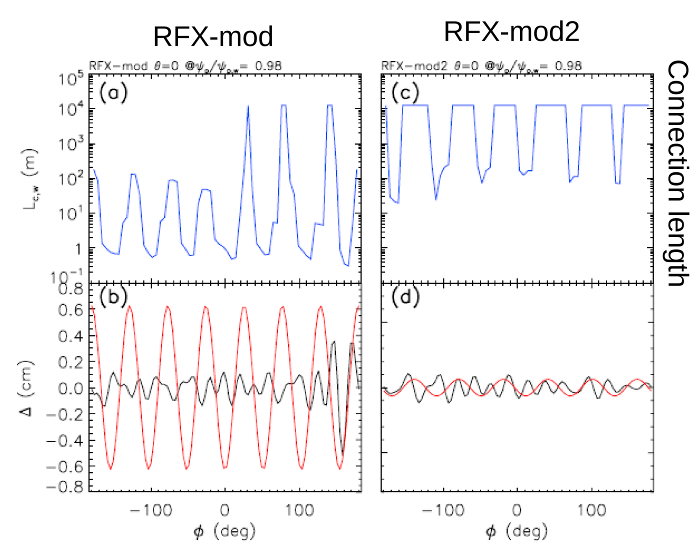
HFS launcher

6 RFX-mod2 Scientific Program

- *Wall conditioning and density control*
  - *Pulse Discharge Cleaning (in H_2 and He) for baking at 180°*
  - *Glow Discharge Cleaning*
    - *Revamped 2 insertable RF capable electrodes*
    - *New 8 fixed electrodes*



- *Fast rotating modes regime*
  - *Optimize feedback control parameters*
  - *Assess plasma current threshold for tearing modes wall locking*
  - *Exploit mode rotation for diagnostic purposes*
- *Edge and SOL physics*
  - *Assess the improvement of the SOL due to reduction of secondary modes*



- *High plasma current regime*
  - *Assess reduction of secondary modes and effect on helical states and on density limit*
  - *Assess scaling of electron temperature*
- *Ohmic Tokamak Plasmas*
  - *Shaped discharges with positive and negative triangularity*
  - *ELM control in electrode-induced H-mode with feedback coils*